B32

(12) UK Patent Application (19) GB (11) 2 247 391 (13) A

(43) Date of A publication 04.03.1992

(21) Application No 9018920.0

(22) Date of filing 30.08.1990

(51) INT CL[5]
A43B 7/08

(52) UK CL (Edition K)
A3B B11

(56) Documents cited
WO 87/03789 A WO 86/03951 A US 4860463 A

(58) Field of search
UK CL (Edition K) A3B
INT CL[5] A43B

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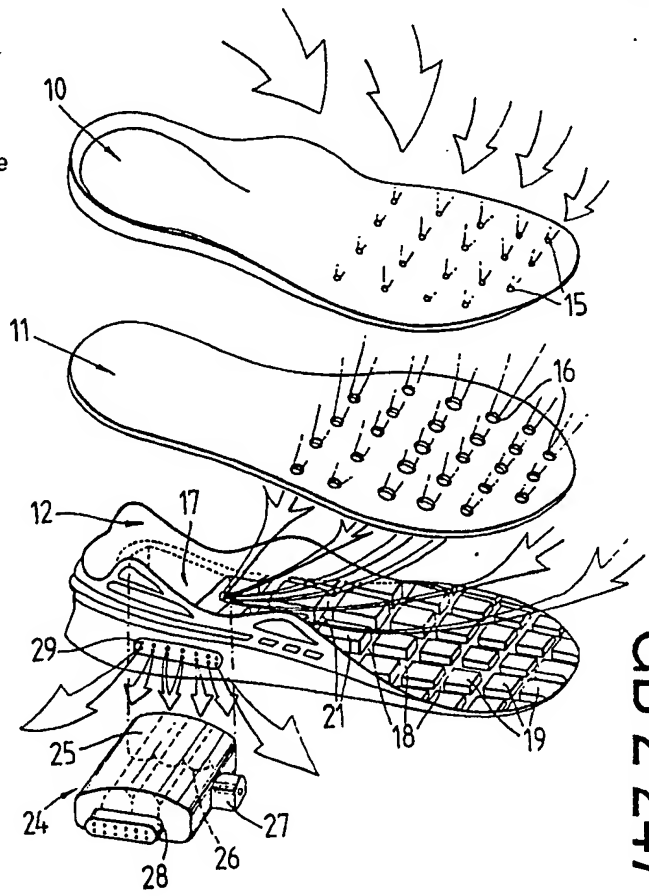
(54) Ventilated footwear

(57) An article of sports footwear has a resilient plastics material chamber (24) received within the heel and has a valved air inlet (27) communicating through airflow channels (18) in a midsole unit and perforations (15) through an insole with the interior of the article, and a valved air outlet (28) communicating with the exterior, so that varying foot pressure during locomotion causes the volume of the chamber to increase and decrease thereby pumping stale air from the interior to the exterior.

Fig.1.



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Ventilated footwear

Legal status (INPADOC) of **GB2247391**

GB F	**9018920 A**	(Patent of invention)
PRS Date :	1994/11/09	
PRS Code :	732E	
Code Expl.:	PROCEEDING UNDER SECTION 32 PATENTS ACT 1977	
PRS Date :	1995/02/22	
PRS Code :	WAP	
Code Expl.:	- APPLICATION WITHDRAWN, TAKEN TO BE WITHDRAWN OR REFUSED ** AFTER PUBLICATION UNDER SECTION 16(1)	

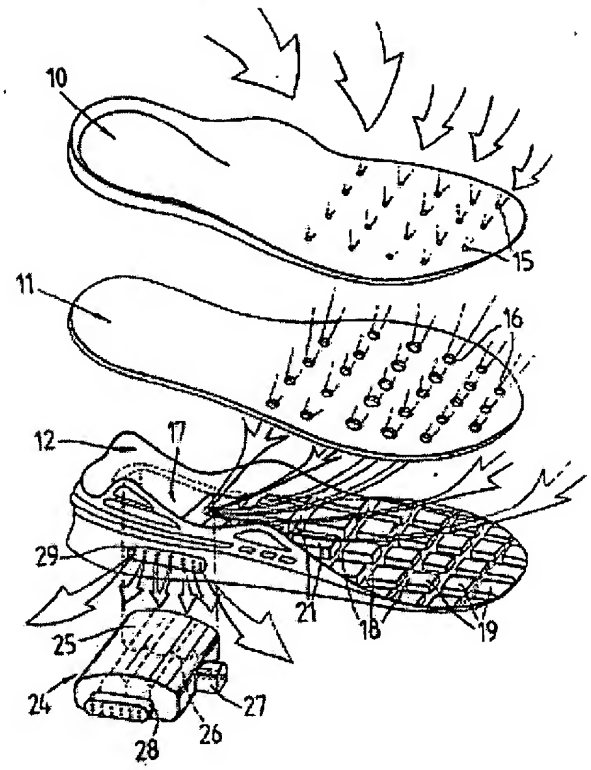
Ventilated footwear

Patent number:	GB2247391
Publication date:	1992-03-04
Inventor:	KING CLIVE NIGEL
Applicant:	TRIPLE THREE LEISURE LIMITED (GB)
Classification:	
- international:	A43B7/08
- european:	A43B7/08P
Application number:	GB19900018920 19900830
Priority number(s):	GB19900018920 19900830

Abstract of **GB2247391**

An article of sports footwear has a resilient plastics material chamber (24) received within the heel and has a valved air inlet (27) communicating through airflow channels (18) in a midsole unit and perforations (15) through an insole with the interior of the article, and a valved air outlet (28) communicating with the exterior, so that varying foot pressure during locomotion causes the volume of the chamber to increase and decrease thereby pumping stale air from the interior to the exterior.

Fig.1.



Ventilated footwear

Description of **GB2247391**

FOOTWEAR
This invention relates to footwear.

The design of high quality footwear has long involved an inherent conflict between the technical requirement for firm support of the wearer's foot and ankle and the technical requirement for ventilation. Athletic and sports footwear, including so-called trainers, require close fitting to maintain firm support as the wearer runs, twists, accelerates and stops while the complex structure of the foot and ankle repeatedly bends, twists and flexes through wide and variable angles and curves in three dimensions.

The insole of the shoe sole assembly should maintain close supporting contact with the heel, arch and toes and desirably provide a combination of firmness and springiness appropriate to the particular use or sport. The upper should similarly maintain close supporting contact with the upper and side surfaces of the foot, and often the ankle as well, and provide a combination of support and flexibility appropriate to a particular use or sport.

The conflicting technical requirement is for ventilation.

Activity generates heat and perspiration and all footwear must therefore be adapted to allow the foot to breath at least to some extent to avoid build-up of stale sweaty air and conditions for fungal infections to thrive. The conflict is acute where the footwear is required to give firm support andi-s worn for long periods, e.g. trekking and hill walking footwear, and where the footwear is required to give excellent support because the activity is intense, for example in basketball and tennis.

An object of the present invention is to provide an improved technical solution to the above described conflict problem, whereby good ventilation can be maintained without sacrificing firm support, and a further object is also to provide for a selected degree of extra springiness to assist the wearer's walking and running movements.

According to the present invention there is provided an article of footwear comprising a variable volume air chamber extending within the heel portion, the chamber having a valved air inlet communicating with the interior of the article of footwear and a valved air outlet communicating with the exterior of the article, whereby a wearer's varying foot pressure during locomotion causes the volume of the chamber to increase and decrease thereby pumping stale air from the interior to the exterior of the article of footwear.

The chamber is preferably defined by a resilient boundary wall and is conveniently manufactured as a separate unit from a tough resilient plastics material. The valved air inlet and outlet are preferably one-way flap valves and are conveniently formed of flaps of the same resilient plastics material.

There may be one or more air inlets and one or more air outlets. The or each air outlet communicates with the exterior of the article and are thus potentially exposed to the environment including water, mud and physical damage.

It is therefore preferred to provide a screen member having a plurality of relatively restricted final outlet flow apertures, e.g. on each side of the heel. The flap valves work at the outlet apertures fromthe-chamber spaced inwardly from the screen members for protection from the environment and to prevent ingress of water into the air chamber.

The air inlet is generally within the finished footwear article and thus protected from the environment by the heel and sole structure. Accordingly a single air inlet with a relatively large flow aperture can be provided.

The chamber is preferably adapted to provide a selected degree of springiness during locomotion. When the wearer has that foot off the ground the chamber will be at or near maximum volume. As that foot next returns to the ground the volume of the chamber diminishes as foot pressure is applied thereby

compressing the air within the chamber to cause air to be expelled through the valved air outlet or outlets. The progressive pressure rise within the chamber as the volume reduces provides air cushion springiness and as the foot pressure passes its peak value the air pressure tends to re-expand the chamber volume and return some stored energy upwardly to the lifting foot. The degree of springiness will depend on the volume rate at which air is at the same time being expelled through the outlet valves to the exterior.

The chamber preferably has an upwardly convex resilient upper wall whereby the chamber volume diminishes progressively further as greater foot pressure is applied thereto, e.g.

during running as contrasted with walking.

The chamber is preferably operated by means of a relatively stiff insole boarding member disposed beneath the insole and above the sole unit. The heel end of the boarding member is supported by the chamber and thus serves as a lever to compress the chamber as heel pressure is applied to the lever.

The or each insole preferably has a plurality of perforations over a substantial area to allow stale air to move therethrough from the interior of the article.

The sole unit is provided with airflow channels communicating with the perforations and allowing the stale air to flow to the chamber inlet. As the foot rises at the end of a step, foot pressure is removed from the chamber, the chamber expands towards its relaxed volume and the air pressure falls. When the air pressure passes from above ambient to below ambient atmospheric pressure the air outlet valve closes and the inlet valve opens to allow the expanding pump chamber to draw stale air into the chamber through the insole perforations and along the channels in the sole unit.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:
Figure 1 is a perspective exploded view from above of the insole and sole units of an article of footwear according to the invention; and
Figure 2 is a perspective view from below of the units with a sole section shown removed to aid understanding.

The drawings show exploded views of the sole assembly of an article of sports footwear. The upper may take any 'form and be constructed from any materials well known to those skilled in the footwear arts and appropriate to the particular use or sport. The sole assembly comprises an insole 10, and insole boarding member 11, a midsole unit 12, an outer sole 13 and an outer sole insert section 14.

The insole 10 has a plurality of perforations 15 primarily in the arch and toe area, the insole boarding 11 is formed of relatively stiff material to serve as a resilient lever and also has a plurality of perforations 16 in general alignment with perforations 15. The midsole unit 12 is suitably a polyurethane moulding which is formed with a generally rectangular cross-section vertical opening 17 (Figure 1) in the heel and arch area and with a grid of air flow channels 18 in the ball and toe area. The channels 18 extend longitudinally and transversely on the upper surface of the midsole unit and are primarily defined by a plurality of generally rectangular blocks 19 which diminish in height and in longitudinal dimension progressively from - adjacent the opening 17 towards the toe area. The perforations 16 communicate with the channels 18.

The outer sole1 3 has an opening 20 which corresponds in shape with opening 17 in the midsole unit 12. The sole insert section 14 fits within the opening 20 and is sealed therein in final assembly of the footwear.

The sole 13 and section 14 together present a typical patterned and profiled ground gripping under surface appropriate to the use or sport. The forward portion of the upper surface of section 14 is formed with blocks 21 providing channels 22 that match and complete the channel grid provided primarily by the midsole unit 12. The rear portion of the upper surface of the sole section 14 is planar as indicated at 23 in Figure 2.

It will therefore be appreciated that the sole assembly incorporates a cavity formed by the opening 17. The cavity is closed at the top by the rear portion of boarding member 11 and is closed at the bottom by the surface 23 of the sole section. The sole section 14 is relatively rigid but the boarding member 11 serves as a resilient lever whereby its rear portion can flex into the opening 17 under heel pressure.

The cavity formed by the opening 17 receives a pump unit in the form of a chamber defined by a resilient

boundary wall 24. The chamber is dimensioned to be a snug fit within the cavity 17 when the shoe is assembled and is not occupied by a foot. In this condition the chamber contains air at ambient atmospheric pressure, its lower surface rests on the surface 23 of the sole section 14 and its upper surface lightly supports the stiffly flexible lever formed by the rear portion of boarding member 11.

The chamber 24 is formed as a separate unit from a tough resilient plastics material giving the chamber 24 a specific shape and volume when unstressed. The upper boundary wall is an upwardly convex wall 25 curved in the longitudinal sense, and the lower wall is shaped to provide a number (4 in the illustrated embodiment) of downwardly convex part-tubular profiles 26 extending laterally of the shoe.

The pump unit includes a valved air inlet 27 at its forward end wall communicating into chamber 24 from the interior of the shoe via the channels 22 and 18 and the perforations 16 and 15. The pump unit also includes a pair of valved air outlets 28 at its opposite side walls communicating from chamber 24 to the exterior of the shoe.

The air outlets 28 include screen members 29 providing a plurality of relatively small diameter final flow outlet apertures, and are snugly received in lateral openings in opposite sides of the heel of the midsole unit 12.

The valved air inlet 27 and outlets 28 each include a one-way flap valve formed of flaps of the same or similar tough resilient plastics material as the walls of the chamber 24. Thus when the chamber 24 is compressed its internal volume reduces and its internal air pressure rises causing the inlet valve to close and the outlet valves to open thereby pumping air out through the screens 29 in the sides of the heels. When compressive force is removed from the chamber 24 the elevated internal air pressure and the natural resilience of the walls causes it to return towards its natural unstressed shape so that the internal air pressure falls. As the pressure falls below ambient pressure the outlet valves close and the inlet valve opens drawing air into the pump chamber from the channels 22 and 18.

When the shoe is occupied by a foot a proportion of the weight of the wearer is borne by each heel which bears down on the lever of the boarding member 11 and is therefore in turn supported by the boundary wall resilience and the air cushion of the pump chamber 24. During locomotion the heel pressure varies from a maximum as the shoe engages the ground at the beginning of a stride to a minimum as the shoe leaves the ground at the end of the stride.

As heel pressure increases to a maximum the pump chamber is compressed thereby simultaneously providing a degree of air cushion foot support and expelling stale air from within the chamber. As heel pressure decreases again the chamber returns towards its natural unstressed shape simultaneously returning some stored spring energy to the lifting foot and drawing in stale air from channels 22 and 18 and thereby ultimately from within the shoe through apertures 16 and 15 achieving effective forced ventilation.

Ventilated footwear

Claims of **GB2247391**

CLAIMS:

1. An article of footwear comprising a variable volume air chamber extending within the heel portion, the chamber having a valved air inlet communicating with the interior of the article of footwear and a valved air outlet communicating with the exterior of the article, whereby a wearer's varying foot pressure during locomotion causes the volume of the chamber to increase and decrease thereby pumping stale air from the interior to the exterior of the article of footwear.

2. An article of footwear according to claim 1 wherein the chamber is defined by a resilient boundary wall.

3. An article of footwear according to claim 2 wherein the chamber is manufactured as a separate unit from a resilient plastics material.

4. An article of footwear according to claim 3 wherein the valved air inlet and outlet comprise one-way flap valves formed of flaps of said resilient plastics material.

5. An article of footwear according to any one of claims 2 to 4 wherein the chamber has an upwardly convex resilient upper wall whereby the chamber volume diminishes progressively further as greater foot pressure is applied thereto.

6. An article of footwear according to any one of claims 2 to 5 wherein the chamber is operated by means of a relatively stiff insole boarding member disposed beneath an insole and above a sole unit of the article of footwear, the heel end of the boarding member being supported by the chamber to serve as a lever to compress the chamber as heel pressure is applied to the lever.

7. An article of footwear according to any one of claims 1 to 6 including an insole having a plurality of perforations over a substantial area to allow stale air to move therethrough from the interior of the article of footwear.

8. An article of footwear according to claim 7 including a sole unit provided with airflow channels communicating with said perforations and allowing the stale air to flow to the chamber inlet.

9. An article of footwear substantially as described herein with reference to the accompanying drawings.

Fig.1.

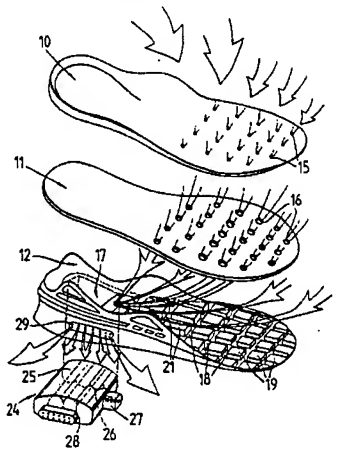


Fig.2.